

Reburning Projects in the Department of Energy's Clean Coal Technology Demonstration Program

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Summary

The Clean Coal Technology Demonstration Program (CCTDP) is a government and industry co-funded effort to demonstrate a new generation of innovative coal utilization processes in a series of facilities built across the country. These projects are carried out at a commercial scale to prove technical feasibility and provide the information required for future applications. A major component of the CCTDP is a series of projects that address environmental control issues, with particular focus on minimizing emissions of sulfur dioxide (SO₂) and nitrogen oxides (NO_x) from coal burning power plants. The CCTDP, initiated by Congress in 1986, is continuing. This paper reports on the four completed CCTDP projects (out of a total of 35 projects) that involved coal reburning or gas reburning for NO_x reduction.

The four CCTDP reburning projects were conducted at six locations, as follows:

- Gas reburning coupled with sorbent injection in an 80-MWe tangentially fired boiler at Illinois Power's Hennepin Station (now Dynegy) in Hennepin, Illinois
- Gas reburning coupled with sorbent injection in a 40-MWe cyclone boiler at City Water Power & Light's Lakeside Station in Springfield, Illinois
- Gas reburning coupled with low-NO_x burners (LNBs) in a 172-MWe wall-fired boiler at Public Service of Colorado's Cherokee Station (now Xcel Energy) in Denver, Colorado
- Coal reburning in a 100-MWe cyclone boiler at Wisconsin Power & Light's Nelson Dewey Station (now Alliant Energy) in Cassville, Wisconsin
- Micronized coal reburning in a 148-MWe tangentially fired boiler at New York State Electric & Gas's Milliken Station (now AES Cayuga) in Lansing, New York
- Micronized coal reburning in a 60-MWe cyclone boiler at Eastman Kodak Company's Kodak Park power plant in Rochester, New York

The coal reburning process demonstrated at Nelson Dewey was developed by The Babcock & Wilcox Company. The remaining coal- and gas-reburning technologies were provided by Energy & Environmental Research (now GE Energy). The design fraction of heat input provided by reburning varied from 10% to 30%. In all six cases, the NO_x reduction achieved through reburning exceeded the target goal of 50%. These results demonstrated the feasibility of substantially reducing NO_x emissions over a wide range of coals and combustor types.

At Hennepin and Lakeside, gas reburning is no longer in operation, primarily because of the high price of natural gas. Plant-wide NO_x reduction requirements for each of these units are being met by control measures installed at other, larger units. Coal reburning at Nelson Dewey has not been retained. Overfire air (OFA), which was also a part of the demonstration project, provides sufficient NO_x reduction to meet the regulatory requirements for this location and is less expensive to operate than reburning. Gas reburning has been discontinued at Cherokee, primarily for the same reason. In this case, contributing to the higher operating cost is, again, the high price of natural gas.

The micronized coal reburning operations at Milliken and Kodak Park continue to be used, providing significant NO_x reduction. With reburning and OFA, these boilers meet the current NO_x emissions standard for New York State of 0.60 lb/million Btu. However, at these locations compliance with the newly promulgated, more stringent NO_x emission standard of 0.15 lb/million Btu may require the use of selective catalytic reduction (SCR).

The six CCTDP reburning projects were undertaken at a time when NO_x emissions reductions of 50-60% were sufficient to meet the requirements of Title IV of the Clean Air Act Amendments (CAAA) of 1990, which focused on acid rain. Both coal reburning and gas reburning demonstrated in the CCTDP successfully met this target. Gas reburning offers lower capital cost than coal reburning, but operating cost is higher because of the higher price of natural gas compared with coal. On balance, coal reburning and gas reburning were approximately competitive in the 1990s, when the price differential between gas and coal was less than about \$2/million Btu. At that time, price projections generally indicated that this differential would remain relatively constant over the foreseeable future, and that gas supply would be ample.

Since the 1990s, demand for natural gas in the United States has increased markedly because of accelerated construction and operation of gas-fired power plants, with a corresponding significant increase in price. The current differential between gas and coal, \$3-4/million Btu, is expected to remain in effect for some years to come. As a result, gas reburning is viewed by some coal-burning utilities as economically prohibitive.

Coal reburning and gas reburning have been demonstrated successfully at six coal burning power plants in the CCTDP and, subsequently, at other locations. In the current environment, utilities must balance the viability of reburning against other NO_x reduction technologies in the face of tightened environmental regulations, as determined on a case-by-case basis.